*भारतीय मानक*
*Indian Standard*

**IS 9401 (Part 19) : 2022**

# नदी घाटी परियोजनाओं में कार्य मापन की पद्धति ( बाँध और संबंधित संरचनाएँ )

## भाग 19 वैद्युत-यांत्रिक कार्य

*( पहला पुनरीक्षण )*

# Method of Measurement of Works in River Valley Projects (Dams and Appurtenant Structures)

## Part 19 Electro-Mechanical Works

*( First Revision )*

ICS 93.160

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Measurement and Cost Analysis of Works for River Valley Projects Sectional Committee, WRD 23

## FOREWORD

This Indian Standard (First Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Measurement and Cost Analysis of Works for River Valley Projects Sectional Committee, had been approved by the Water Resources Division Council.

In the measurement of quantities, in the construction of river valley projects, a large diversity of methods exists at present according to local practices. Lack of uniformity creates complication regarding measurement and payments. This standard is intended to provide a uniform basis for measurement of various items of electrical works carried out in River Valley Projects.

This Indian Standard (Part 19) was first published in the year 2009. In this revision the major modifications that are being brought about include addition of explanatory text for making the contents of the standard lucid and self-explanatory. General clause of the standard has been updated to cover the requirements of clubbing of items, booking of dimensions, description of items, dewatering, mill tolerances etc. The table 1 has been updated with the following:

a) Measurement units
b) Site adjustment/extra measurement to reflect the site specific requirements, and
c) Following new items have been added
  i) Mandatory spare parts,
  ii) Special tools and devices,
  iii) Associated transmission system, and
  iv) Drainage dewatering system

This Indian Standard is published in several parts. The other parts in this series are:

| | |
|---|---|
| Part 1 | Excavation for foundation |
| Part 2 | Dewatering |
| Part 3 | Grouting |
| Part 4 | Concrete works |
| Part 5 | Masonry |
| Part 6 | Ventilation pipes and other embedded materials |
| Part 7 | Joints |
| Part 8 | Instrumentation |
| Part 9 | Lining |
| Part 10 | Form work |
| Part 11 | Diaphragm walls |
| Part 12 | Topographical surveys |
| Part 13 | Earth and fill dams |
| Part 14 | Canal works |
| Part 15 | Investigation works |
| Part 16 | Tunneling |
| Part 17 | Hydromechanical and related metal works |
| Part 18 | Sheet piling |

The composition of the Committee responsible for the formulation of this standard is given in Annex A.

For the purpose of deciding whether a particular requirement of this standard is complied with the final value, observed or calculated expressing the result of a test or analysis should be rounded off in accordance with IS 2 : 1960 ‘Rules for rounding off numerical values ( *revised* )’. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

*Indian Standards*

# METHOD OF MEASUREMENT OF WORKS IN RIVER VALLEY PROJECTS ( DAMS AND APPURTENANT STRUCTURES )

## PART 19 ELECTRO-MECHANICAL WORKS

*( First Revision )*

## 1 SCOPE

This standard (Part 19) covers the method of measurement of electromechanical works in terms of units of measurement for the works carried out in river valley projects.

## 2 REFERENCES

The following standard contains provisions which through reference in this text, constitutes provision of this standard. At the time of publication, the edition indicated was valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent edition of the standard indicated below:

| *IS* | *Title* |
|---|---|
| 9401 (Part 2) : 2003 | Method of measurement of works in river valley projects (dams and appurtenant structures): Part 2 Dewatering (*first revision*) |

## 3 GENERAL

**3.1** Electromechanical works are not amenable to simple measurement techniques for the purpose of payment. The bill of quantities is framed in such a way that measurement for the purpose of payment can be done on the basis of completion of various stages of work carried out in accordance with specifications and approved drawings. As such the bill of quantities and detailed scope of work is generally brought out in terms of sets or numbers of equipment.

### 3.2 Clubbing

Items may be clubbed together provided that breakup of clubbed items is agreed to be on basis of detailed description of items, stated in this standard.

### 3.3 Booking of Dimensions

In booking dimensions, order shall be consistent and generally in sequence of length, width, and height or depth or thickness.

### 3.4 Dimensions

Unless otherwise stated all work shall be measured net in decimal system, as fixed in its place, as given in **3.4.1** to **3.4.3**.

**3.4.1** Linear dimensions including diameter shall be measured to the nearest 0.001 m.

**3.4.2** Areas shall be worked out to nearest 0.001 $m^2$.

**3.4.3** Weights shall be worked out to nearest 0.5 kg.

### 3.5 Description of Items

The description of each item shall include conveyance and delivery, handling, loading, unloading, storing, rehandling, installation/erection testing and commissioning including all inputs for finishing to required shape and size.

### 3.6 Work to be Measured Separately

Wherever dewatering is resorted to, it shall be measured in accordance with IS 9401 (Part 2).

### 3.7 Mill Tolerance

Mill tolerances/rolling margins shall not be considered if the weight is determined by standard weight basis. In case where details of actual weights are available the same should be adopted.

## 4 BILL OF QUANTITIES

Items of work shall fully describe the materials/components/processes and truly represent the work to be executed. For the purpose of this standard the works shall be categorized into stages/activities.

### 4.1 Stages/Activities

**4.1.1** Design, engineering, fabrication, manufacture, shop testing, assembly, painting, handling and forwarding etc. of all items including all spare parts, tools and required auxiliaries and accessories.

**4.1.2** Freight and Insurance, including handling, loading/unloading, and delivery up to site.

**4.1.3** Erection, testing and commissioning of all units upto satisfactory operation thereof.

## 5 MEASUREMENTS

Electromechanical works in the river valley projects can be categorized into various items as given below in Table 1. The units of measurement of each works along with site adjustment/extra measurement, wherever applicable, have been mentioned against each item.

**5.1** Unless otherwise specified, the dimensional measurement at works and at site should be carried out during inspections to ensure manufacturing and operational accuracy and completeness of items in accordance with the approved drawings. The approved drawings shall incorporate bill of materials indicating various components with their description, size, quantity, material, specifications, and theoretical weights in case of fabricated components. The bill of materials shall form the basis for ensuring completeness to enable acceptance of sets of different items of works.

**5.2** Unless otherwise specified, an additional allowance of 2.5 percent of the weight of the structure shall be made for shop and site rivet heads in riveted steel structures.

**5.3** Unless otherwise specified, in the case of welded steel structures 1.5 percent of the weight of structure shall be added to the weight.

**5.4** The theoretical weight of components in the bill of materials incorporated in the approved drawings shall be based on unit weight given in relevant Indian Standards. No deduction shall be made for holes of area less than 0.01 $m^2$.

**5.5** The theoretical weights of components in the bill of materials incorporated in the approved drawings shall be based on the details given below:

a) The weight of steel sheet, plate and strip shall be taken from relevant Indian Standards on standard weight basis for every millimeter of sheet thickness. For rolled sections like girders, channels, angles, rounds, steel strips etc, weights given in relevant Indian Standard shall be used.

b) Unless otherwise specified, weights of cleats, brackets, stiffeners, distance pieces, separators, diaphragms, gussets (taking overall rectangular dimension), base plates, packing pieces shall be added to the weight of respective items.

c) For forged steel/steel castings, weight shall be calculated on the basis of relevant Indian Standards.

**5.6** Unless otherwise specified for linear measurement of length, the pipes including welds shall be considered as continuous pipes and the weight shall be calculated on standard weight basis. For bends, the length along each axis of the curve shall be measured and weights be calculated accordingly.

## Table 1 Various Items of Electromechanical Works in River Valley Projects

( *Clause* 5 )

| Sl No | Equipment | Measurement Unit | Site Adjustment/Extra Measurement |
|---|---|---|---|
| (1) | (2) | (3) | (4) |
| i) | Turbine and governor | In No. | Site specific equipment wise/part wise breakup may be made |
| ii) | Main inlet valve (MIV) | In No. | — |
| iii) | Generator, excitation and automatic voltage regulator (AVR) | In No. | Site specific equipment wise/part wise breakup may be made |
| iv) | Bus duct | In lot per unit | Length of main and tap bus conductors with enclosure, in metre, and support structures by weight for site adjustment |
| v) | Generator step-up transformers | Number of transformers installed along with assembly of various auxiliaries at site | — |
| vi) | Cross-linked poly-ethylene (XLPE) or oil filled high voltage (HV) cables | In lots per cable or per unit | The support structure by weight and the length of cable, in metre, for site adjustment |
| vii) | HV switch gear (Gas Insulated Switchgear (GIS), etc.) | In lot per bay | The support structure by weight and the bus duct of each type, in metre, for site adjustment |
| viii) | Pot-yard/switchyard | In lot with respect to each bay /unit | Unit rates/measurement for site adjustment |
| ix) | Direct current (DC) battery system | Lot per battery system | — |
| x) | Control and monitoring system | Lot per section/unit, as applicable | — |
| xi) | Protection system | Lot per section/unit, as applicable | |
| xii) | Power and control cables including cable trays | Lot | — |
| xiii) | 11 kV Switch gear | Lot per section/panel of each type | — |
| xiv) | Diesel Generator (DG) sets including step-up transformers | 'No' of each type of DG | — |
| xv) | Auxiliary and station transformer | 'No' of transformer of each type | — |
| | 415V Switchgear | Lot per section/unit, as applicable | |
| xvi) | Power line carrier communication system (PLCC) equipment | Lot per set | Unit measurement of each equipment of outdoor and indoor installations |
| xvii) | Illumination system | Lot per section/panel | — |
| xviii) | Public address system | Lot | Length of wiring and conduiting including accessories, in metre, for site adjustment |
| xix) | Optical fibre cable link between dam and powerhouse | Lot<br>including termination, etc | — |
| xx) | Electrical workshop | Lot | — |
| xxi) | Electric Overhead Travel (EOT) cranes for power house | No. of cranes Installed and commissioned | — |
| xxii) | Cooling water system | Lot per system | Unit charges for pumps, valves, filters, strainers of each type for site adjustment fire dampers, etc., in m$^2$ |
| xxiii) | Grounding system | lot | — |

**Table 1** (*Continued*)

| Sl No | Equipment | Measurement Unit | Site Adjustment/Extra Measurement |
|---|---|---|---|
| (1) | (2) | (3) | (4) |
| xxiv) | Fire fighting system | Lot | a) Unit price of each type of the equipment of firefighting and detection, etc.<br>b) No. of pumps, valves of each type for site adjustment<br>c) Pipes of each size including fittings by metre<br>d) Unit measurement of fire extinguishers of each type<br>e) Cable, etc., as per S. No.12 |
| xxv) | High pressure (HP) compressed air system | Lot | a) Unit measurement of each type of compressor<br>b) No. of valves of each type for site adjustment<br>c) Pipes of each size including fittings by metre |
| xxvi) | Low pressure (LP) compressed air system | Lot | a) Unit measurement of each type of compressor<br>b) No. of valves of each type for site adjustment<br>c) Pipes of each size including fittings by metre |
| xxvii) | Oil filtration plant | Lot per system for purification of transformer oil and bearing oil | a) No. of valves of each type for site adjustment<br>b) Pipes of each size including fittings by metre |
| xxviii) | Workshop equipment | Lot | — |
| xxix) | Elevators | Lot | — |
| xxx) | Ventilation of tunnels through exhaust blowers and pipe | Per hour of operation of exhaust blowers | Length of ventilation pipe to be considered |
| xxxi) | Air conditioning: | Lot | As per consumption in KW during operation |
| | a) Equipment during operation | | |
| | b) Equipment during installation | | |
| xxxii) | Instrumentation (for seismological quality control lab, water level recorder, meteorological, etc. | Lot | — |
| xxxiii) | Control room equipment and instruments | Lot | — |
| xxxiv) | Water level recorder equipment | Lot | — |
| xxxv) | Telemetry for transmission of hydraulic data | Lot | — |
| xxxvi) | Computerization of the project | Lot | — |
| xxxvii) | Maintenance during operation stage | Lot | — |
| xxxviii) | Transformers of switchyard | No. | — |
| xxxix) | High voltage electrical supply system | Lot per item of each type of equipment/substation/line | — |
| xl) | Warning system | Lot per item of each type of equipment | — |
| xli) | Cable gallery | Lot | Running meter of each size of cable. |
| xlii) | Mandatory spare parts | Lot | — |
| xliii) | Special tools and devices | Lot | — |

**Table 1** (*Concluded*)

| **Sl No** | **Equipment** | **Measurement Unit** | **Site Adjustment/Extra Measurement** |
|---|---|---|---|
| (1) | (2) | (3) | (4) |
| xliv) | Associated transmission System | Km | — |
| xlv) | Drainage dewatering system | Lot | — |

# ANNEX A

( *Foreword* )

## COMMITTEE COMPOSITION

Measurement and Cost Analysis of Works for River Valley Projects Sectional Committee, WRD 23

| *Organization* | *Representative(s)* |
|---|---|
| NHPC Faridabad | Shri J. R. Chaudhary (***Chairman***)<br>Executive Director (Civil) (*Alternate*) |
| Bhakra Beas Management Board, Chandigarh | Shri Rajesh Gupta |
| Central Electricity Authority, New Delhi | Director (HPM Division)<br>Director (*Alternate*) |
| Central Water Commission, New Delhi | Director (Cost APP) (HWF)<br>Director (Cost APP) (IRR) (*Alternate*) |
| Energy Infratech Private Limited, Gurugram | Shri Manoj Kumar Gupta<br>Shri Pramod chand tewari (*Alternate*) |
| Ferro Concrete Construction (India) Private Limited, Indore | Dr Mahavir Bidasaria<br>Shri Er Anupam Bidasaria (*Alternate*) |
| Hindustan Construction Company Limited, Mumbai | Shri Ajit Joshi |
| In Personal Capacity | H. L. Arora |
| Irrigation Department, Govt of Kerala, Thiruvananthapuram | Shri K. A. Joshy |
| Irrigation Department Government of Haryana | Shri Pardeep Yadav |
| Irrigation Department Government of Punjab | Shri Kuldip Singh Takshi<br>Shri Jatinder Pal Singh (*Alternate*) |
| Irrigation Research Institute, Roorkee | Shri Dinesh Chandra<br>Shri Shankar Kumar Saha (*Alternate*) |
| Karnataka Power Corporation Limited, Bengaluru | Chief Engineer (Civil Design) |
| Larsen and Toubro (ECC Limited), Mumbai | Shri K. K. Gupta<br>Shri Santanu Majumdar (*Alternate*) |
| NTPC Limited, New Delhi | Shri Shailendra Kumar Pandey<br>Shri Jagat Singh Yadav (*Alternate*) |
| National Hydroelectric Power Corporation, Faridabad | General Manager (Civil)<br>Deputy General Manager (Civil) (*Alternate* I)<br>Senior Manager (Civil) (*Alternate* II) |
| North Eastern Electric Power Corporation Limited, Shillong | Shri B. C. Bora |
| SJVN Limited, Shimla | Shri M. C. Verma<br>Shri V. K. Gupta (*Alternate*) |
| Sardar Sarovar Narmada Nigam Limited, Gandhinagar | Chief Engineer (Design)<br>Shri V. K. Gupta (*Alternate*) |
| THDC India Limited, Rishikesh | DGM (OMS-Civil)<br>AGM (Cost Engg) (*Alternate*) |
| Water Resources Department, Government of Madhya Pradesh, Bhopal | Chief Engineer, Bodhi W.R.D |

| *Organization* | *Representative(s)* |
|---|---|
| Water and Power Consultancy Services Limited, New Delhi | Head (Civil Designs)<br>General Manager (Hydro-Power) (*Alternate*) |
| Water Resources Dev and Management, IIT Roorkee | Shri Gopal Chauhan |
| BIS Directorate General | Shri Dwaipayan Bhadra Scientist 'E' and Head (WRD)<br>[ Representing Director General ( *Ex-officio* ) ] |

*Member Secretary*

Ms Lalthan Pari
Scientist 'E' (WRD), BIS

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